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(Ex.)

An Inaugural Dissertation on Tetanus.

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for the degree of Doctor of Medicine at the University of Pennsylvania

By

Hiram Corson

of

Pennsylvania

To the Professors of the University of

Pennsylvania

This Dissertation on the nature

cause and Treatment of

Tetanus

is most respectfully inscribed, as

a slender tribute of thanks, for

the many useful and instructive lessons received from

them, by the

Author

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Tetanus

This disease, as defined by most authors, is a greater or less contraction of the muscles of the whole body, with tension, and rigidity of the parts affected. It is divided into four species, distinguished by appellations which express rather the different inflexions of the body, than any variety with respect to the disease itself. It is called Trismus when confined to the muscles of the jaws and neck, Emprosthotonos when the body is bent forward, Opisthotonos when it is bent backwards, and Tetanus when the whole body becomes stiff, and preserves its ordinary rectitude. There is also another species of this disease, mentioned by some writers, in which one side of the body only is affected by spasm, which, consequently, bends the body to the side affected. This is called Tetanus Lateralis or Pleurosthotonos, it is very rarely seen. Tetanus may occur in every

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climate, but it occurs mostly in warm coun-tries, in the warmest seasons of those countries and seems to be materially assisted by cold and moisture suddenly succeeding great heat. It attacks people of all ages, sexes, and tem-peraments, but the middle aged seem more liable than either the old or young, males more than females, the strong and vigorous more than the feeble. In the southern states, this disease is of midling frequent oc-curence, but here, it must be considered somewhat rare; many practitioners not mee-ting with a single case during many years extensive practice. This disease, agreeably to the writings of Doctors Rush and Mosely, is not confined exclusively to the human species, they having seen horses that were affected by it.

Symptoms

Tetanus occurs sometimes suddenly and is then, commonly, very violent. It more fre-

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-quently, however, comes on slowly, and gradually advances to a state of great violence. In the latter case, a slight stiffness is perceived or felt at the back of the neck, which as it increases, causes pain and prevents the free motion of the head; an uneasy sensation is soon perceived at the root of the tongue, followed by difficulty of deglutition; a tightness is felt across the chest, and a pain at the lower end of the sternum shooting through into the back, the muscles of the jaws become affected and keep them firmly closed, and the disease may now be termed Trismus. Should the disease proceed, the muscles of the back become affected, so as to draw the neck and trunk of the body backwards, constituting Opisthotonos. If on the contrary the muscles on the front of the body had been affected, so as to bend the body forwards, it would have been called Emprosthotonos, - but this seldom occurs. The abdominal muscles are mostly

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violently contracted even in opisthotonos. If the disease advances, the muscles of the extremities become affected and extend them, the flexors of the head and trunk become now affected, so as to straighten the trunk and constitute complete Tetanus. The spasms in this disease are always ~~are always~~ accompanied with violent paind, but, the extreme violence of the spasm does not usually last more than two or three minutes, when a relaxation takes place in a slight degree with a proportionate abatement of the paind, but it commonly occurs again every ten fifteen or twenty minutes, according as the attack is violent, or the exciting causes applied, although it seems often to be renewed without any, evident exciting cause. Fever is sometimes, though not always, an attendant of spasm in this disease. The pulse is commonly precipitate, and irregular, in the heighth of the spasm, though Cullen says that, sometimes when the spasms are extremely

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violent, the pulse is more full and frequent than natural. Blood drawn in this disease seldom shows signs of inflammation. The excretions are commonly suppressed, especially the stools, violent constipation nearly always being present. The respiration is commonly difficult, probably on account of the contractions of the thoracic muscles and confined situation of the diaphragm. Larry in his treatise on traumatic tetanus says, "the heart is bound and becomes rigid in the same manner as other muscles and thus causes an enfeeble circulation". That the heart, being a muscular organ, should be affected by spasm is no way strange, but I am induced to believe, that although it may be affected with spasmodic contractions, that those contractions are not so violent, nor of so long continuance, as those under which the external muscles suffer; for, it appears to be necessary in order to keep up a circulation through the arteries, that as

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soon as the heart has contracted upon the blood in the ventricle, and expelled it, a relaxation should take place that the ventricle may again be filled. Let us suppose now that the heart is held in a state of violent contraction for a single minute, would there not be in this case a total stop of the flow of the blood into the arteries from the heart? and would not the pulsation at the wrist cease? If those things would take place when the heart was in the state supposed above, surely it cannot be in that state in Tetanus; as Cullen says that the pulse is sometimes in cases of extreme violence more full than natural; and other writers agree in saying, that it is continued with but little variation in point of number from what it is in health. To proceed with the symptoms; there is commonly in the commencement nausea, and sickness of stomach, the heat of the body is sometimes increased, at others natural, a cold sweat sometimes breaks out on the face, and limbs, the urine, though sometimes voided with dif

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-ficulty, and deficient in quantity, is not always so. The deglutition is sometimes entirely obstructed, and the patient suffers the most intolerable anguish. Every organ of voluntary motion seems now to be affected, the eye is immoveably fixed in its socket, the countenance of the patient is hideous and distorted, and while in this state the strength fails, the pulse becomes irregular, and one universal convulsion puts an end to the life of the patient, who often is in so full possession of his mental faculties, as to be perfectly sensible of the fate which awaits him, the brain in this disease, becoming so disordered as to destroy judgment, only in the very last moments of life - In traumatic tetanus the symptoms of the early stage are somewhat different. The wound if suppuration has commenced ceases to dischange pus, the flesh becomes dry, bloated, first of a red, then of a mottled colour; the whole limb becomes painful, the wound inflames, convulsions with

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cramps ensue, the muscles of the jaws and throat become suddenly or gradually affected, and the disease goes on as usual. It sometimes comes on after the diseased part has healed. Tetanus from punctured or lacerated wounds is the most common kind

Causes

Cold has long been considered as a cause of tetanus, and, is said to act more powerfully when combined with moisture. As cold is a negative agent it acts in an indirect manner. When long continued it produces its effects probably by inducing debility which favours the action of exciting causes. When applied suddenly, and with some force, it probably, acts as an exciting cause, by so diminishing the excitement, as to induce convulsive action. Heat has long been considered as having a material influence in producing tetanus, and this was ascribed by Doctor Rush to its debilitating effects, That heat does produce debility almost any one's ex

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perience may inform him. It is also caused by substances which irritate the Primæ viæ, as the acrid matter of dysentery, worms, ardent spirits, miasmata, poisons, constipation, severe labour &c, and is, when it arises from those causes, called idiopathic tetanus; but, when it arises from a scratch, puncture, lesion of a nerve, gun shot or other injuries, it is called symptomatic or traumatic tetanus. This distinction is well enough, as will appear when we come to the treatment of the disease, which is somewhat different in the two cases, but they are probably both symptomatic of irritation in diffent parts of the bodies, but which in both cases becomes transmitted to the same place which then becomes the seat of disease

Pathology

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ting it, but will merely make some remarks which its analogy with other diseases has suggested to me. Many of the symptoms, of Hysteria, Epilepsy, and other convulsive diseases, from their bearing a close analogy to the symptoms in tetanus, induced me, in the early part of my medical studies, to look upon them as being diseases of a milder character than Tetanus, but arising probably from the same part being affected in all cases, though in different degrees according to the disease produced. The causes, of those diseases also in many cases being the same, gave additional support to my opinion; but it was not, till I found that Doctor Chapman in his Therapeutics had promulgated the same opinion and instituted a plan of treatment accordingly, that I was incited more closely to examine into the causes, and seats of those diseases. Many of those causes, which we have enumerated as producing tetanus, we may find recorded by many writers as producing those diseases of which it ma

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be considered an aggravated state,- thus epilepsy has been caused by acrid matters, or indigestible food in the stomach, by worms, constipation &c. The same causes have also been considered as giving rise to Hysteria. Colica Pictonum and Chorea Sancti vitæ are also caused by irritants in the alimentary canal; "a disease also, occasionally, arises from something causing irritation in the primæ viæ, which so nearly resembles that arising from the bites of rabid animals, as to be with difficulty distinguished from it". Those facts, seem to prove very clearly, that there is a very close, and intimate connexion, between convulsive or spasmodic affections, and primary irritation in the stomach, and bowels. But while those facts strengthen the opinion that irritation of those parts does produce tetanus, it does not prove it to be the immediate seat of the disease. I am, from circumstances which I shall proceed to notice, inclined to believe, that the causes, of all spasmodic diseases, produce their effects through the me-

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dium, of the sensorium commune, or the origin of the nerves of the brain and spinal marrow. This opinion is strongly supported by the experiments and observations of Doctor Phillips in his "inquiry on the relation between the nervous and sanguiferous systems". He says that "neither chemical, nor mechanical stimuli, applied to the nervous system, excite the muscles of voluntary motion, unless they are applied near the origin of the nerves of the brain and spinal marrow". The seat of tetanus may, therefore, be located in the central portion of the nervous system, or as it may be called, central organ of perception and volition, and which is infered, from the experiments of some anatomists, to be the Medulla oblongata, which, according to the experiment of Charles Bell, is composed of three portions of matter which seem in a manner distinct from each other, each one governing a distinct set of organs. "Irritation of the upper portion, of the Medulla oblongata, occasions spasm & convulsions

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of the voluntary muscles, and irritation of the lower portion of it, and the upper part of the spinal marrow produce spasm &c of the muscles of respiration, of the voice, and face as expressing the passions. It appears therefore, from the above, that in order to the production of convulsive, or spasmodic action of the muscles, that this part of the nervous system must be irritated, and this may be either primarily, or secondarily. In case of matter irritating the stomach the irritation may be transmitted to the medulla, through the medium of the sympathetic and par vagum, the latter of which originates there. It would seem therefore, that in Tetanus, it is the upper portion which is most affected, while in Hydrophobia the lower portion is most affected, as it is the respiratory muscles which are under influence in the latter case, and the voluntary ones in the former. Many of the symptoms which occur in tetanus, as the expression of the face, the early affection of the throat, ~~&c~~ ~~&c~~ the small

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muscles of the glottis also, sometimes becoming affected by spasm, so as to cause immediate death by closing the glottis and producing suffocation, and knowing, that, in all mortal cases of disease, death takes place from an influence extending over the respiratory system, induce us to believe that the respiratory nerves are considerably affected in this disease. Without speaking of the theories which have been advanced by different writers on the pathology of this disease, I will here conclude mine, conscious that if there is any thing of importance in what I have written, the merit is due to those whose labours have thrown light on the subject. My own opinions are those of one, who is far from possessing an accurate knowledge of all that is necessary to enable him, to lay down the true pathology of Tetanus. In forming a prognosis, we are to be influenced by several circumstances, such as the cause and violence of the attack, the length

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of time it has existed, and the present situation of the patient. Tetanus from wounds is more fatal than the idiopathic species, and the symptoms said to be favorable, often fail to be so, such as white tongue, copious discharge of urine &c. A cold clammy moisture with cold limbs, is said to portend death. It is said to be favorable after the fourth day, and, still more so the longer the disease continues.

Prophylaxis

Although few diseases could be more easily prevented in the forming stage than this, yet on account of the causes, producing it, more frequently, causing other diseases, and at times scarcely making an impression on the system, remedies for its prevention are seldom used, till the precursory symptoms arise. To these then, we should be particularly attentive. In the case of wounds, however, we may dread the approach of tetanus, when a wound heals without much inflammation, it being

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found that a considerable inflammation, either natural or artificial, is one of the surest preventatives of tetanus. If therefore, when the symptoms of traumatic tetanus are to be apprehended, we were to create an inflammation in the injured part, as, caustics, incisions, turpentine &c, and give something to allay the irritability of the system as Opium, we might often prevent it from proceeding. Even in the forming stage of idiopathic tetanus it has been arrested, by the exhibition of Opium. If the disease however is not arrested here, we must resort to remedies, which seem likely to afford relief, and those will be considered in the

Treatment

We are called upon here to remove the cause producing the disease and to do away the irregular and diseased excitement of the system. As there is some difference between the idiopathic and traumatic species of this disease I will treat of them separately and first of the idiopathic species. When therefore

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this disease is produced by irritants in the alimentary canal, it would seem that, we should attempt the removal of the cause by either Cathartics or Emetics. Besides removing the particular matter which might be supposed to cause the disease, keeping the bowels open, or removing the constipation which so invariably attends, will be found most likely, to be an object of much importance. Cullen says, that "from whatever cause costiveness is induced, whether as a symptom of the disease or from the opium that is commonly used, it must be held to aggravate the disease", and, therefore, directs purges to be given while deglutition remains, and, Enemata when it does not. It will be found, I think, upon an attentive examination of the details of many cases of tetanus reported by writers, that where the bowels have been opened and then been suffered to become again constipated, that, as the constipation increased, were the symptoms aggravated. Cases of tetanus said by physicians to be caused by worms, indigestible substances,

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constipation &c, and cured by purging, evince pretty clearly their importance. Their propriety, as remedies in tetanus, is still further confirmed by knowing, that they are nearly always successful in that spasmodic disease of children, called Trismus Nascentium, arising from the irritation produced by a retention of the meconium. Moseley says that Barrere a French physician who practised at Cayenne used purges with much success. Many others speak highly of them, and I think there is sufficient evidence of their utility in this disease alone, without speaking of its efficacy in those to which I hold it to be nearly allied, to warrant us in making trial of it. In Epilepsy, Hysteria, Chorea, sancti vitti, few distrust the efficacy of purges. To open the bowels active purgatives would probably answer best, as they would soonest effect the object. For this purpose might not the croton oil be a proper article, as it is prompt in its operation, and seems to exert a peculiar influence

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over the nerves. Use what we may to evacuate the bowels, we should study to keep them open during the whole course of the disease. Emetics might also I presume be used with advantage in Tetanus. Nearly all who have treated this disease complain of the torpid state of the stomach, which in many cases does not seem to be affected by the most powerful medicines. To do away this torpor of the stomach and render it susceptible to the impression of medicines, emetics are eminently qualified, and they often by their powerful impression on the system allay spasm, remove difficulty of breathing, and, by their wide spread influence assist materially in tranquilising morbid excitement, while in spasmodic affections, arising from irritation in the canal, they have proved peculiarly useful. In tetanus arising from cold they would doubtless prove highly important; but in this case the internal use of Stimulants, as volatile alkali, wine, opium &c, and the use of the warm bath and other means which will produce diaphoresis,

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would probably be a better plan; as the pulse in this disease is small, the skin cold &c. With this plan we will cause the system to react, and may then use purges and such other means as we may deem necessary. Dr Rush says he has cured some incipient cases of Tetanus by emetics. These medicines will not act at all times, and, in such cases we might try an enema of Tartarized antimony as used by Professor Chapman in case of locked jaw with success. What would be the effects of an injection of an infusion of tobacco in a case of great obstinacy? - Of blood letting as a remedy in Tetanus I will now say something. This has not been much extolled by physicians though a few recommend it. Dr Moseley says the spanish surgeons in the colonies resorted to it, with great confidence in its powers. Larrey used it with much success. Hillary recommended it, and most writers admit that it is proper where fever attends. What medicine can vie with this in the promptness of its operation, in relieving the spasm in Colic, Hysteria, Locked jaw,

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and others of like nature? Two cases of Trismus coming within my own knowledge were treated by copious venesection, aided by small portions of Opium with prompt and almost unlooked for success. Bleeding even to syncope might I think in violent cases be tried, as it has according to Larrey terminated the disease when it hap-pened in amputation. That blood-letting is one of the most powerful antispasmodics is a fact supported by both reason and experience. The remedies used to overcome the diseased excitement of the muscles by exciting another superior to it are Opium, Wine, Mercury &c. Of some of them I will treat and first of Opium. The cures from this drug are said to be more numerous than from all others combined. That it has cured in numerous instances, we will all readily believe that it has often failed when used under cir-cumstances favourable for its exhibition we are

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forced to admit. Opium may be given in this disease in doses sufficient to astonish us, and yet it will at times, produce no evident effects on the system. In such cases the stomach must be in a state of great torpor. Should not an emetic precede the Opium here? Many are opposed to using large doses when small ones make no impression on the system. When we exhibit this article and it allays the spasm, its use should by all means, be continued, so as to prevent its recurrence. Incipient and even confirmed cases of this disease are no doubt frequently cured by Opium alone. Its powers are said to be much increased by a combination with other substances, as alkalies, Camphor, Wine and others. This drug is no doubt entitled to much of the praise lavished on it by writers but that there are cases to which it is not applicable will I hope be admitted

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Its external use in the form of plaister applied to the jaws has been much praised in Tiismus. Bark and Wine have been used separately, and in combination, and are said to have proved useful in some cases when used in large doses. about the quantity of Opium to be given at once we cannot speak, as it will depend on the severity of the attack and other circumstances. For a long time the use of the warm bath was commended highly, but is now pretty generally made to give way to the cold bathing. Cullen speaks highly of this remedy and says it is made use of over the whole of the West Indies. Barrere a french physician who practised long since placed great reliance on it. The commond mode of applying cold water is to throw it upon the patient, or plunge him into it, then lap (wrap) him in blankets, administer Opium, and put him to bed. Cold water, in many diseases, is a powerful agent, as it arouses the dormant susceptibility of the system, removes spasmodic contraction of the extreme ves-

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in Tetanus let the writings of those who have tried
it attest. Hippocrates speaks well of it. Mercury,
used so as to effect salivation, has been much
extolled by some while others complain of its in-
-efficacy on account of the difficulty of putting
the system under its influence. As it appears that
the symptoms have given way to a salivation,
would it not be proper, besides using calomel purg-
-ges to remove the contents of the bowels, to effect
a salivation in the manner it was produced by
Addington of London with corrosive Sublimate
numerous are the remedies which have been tried
in this disease to enumerate them would be use-
-less. The spts Turpentine, Oil of Amber &c are of the
number. So seldom is it that practitioners succeed
twice with the same remedy, that we should,
in a case of this kind, fly from one to another, as
they proved unavailing, till we had made trial
of all that held out a prospect of relief — — —

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Traumatic Tetanus

The first object here is to remove the irritating cause producing the disease, if practicable, or to cut off the communication between that and the brain. When Tetanus proceeds from small wounds, punctures, or incisions, and causes of like nature, we should make free incisions into the part, if this can be done with safety, and then applying to it irritating or caustic substances as Cantharides, Turpentine, nitrate of silver &c. Dr Rush says, he never yet knew a case to continue, when the spirits of Turpentine was applied in time. Some use caustic to the wound and then poultice it to obtain suppuration. Holding the part, if on any of the extremities, in hot ley, after incisions have been made, is a practice much followed, in the country, and with great success; opium being given internally at the same time. If the irritated part be a finger or toe it might be amputated. Opium, Musk, Castor, Camphor and Turpentine, are among the internal remedies used

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in traumatic Tetanus. The bowels should I think be kept in a laxative state if possible, and bene-section occasionally be resorted to, as in the other species. Opium should be given freely sometimes. Blisters to the spine, from top to bottom, have been found very beneficial, but far better is the application of caustic potash along the whole course of the spinal column. This practice is pursued by Doctor Hartshorne of this city with whom I believe it originated*. It is said to be a very effectual practice, and should be tried in all cases of tetanus, when likely to prove obstinate. Larrey who had to contend with many cases of this disease during his campaigns, says, "that of all the remedies proposed by skilful practitioners experience has proved to me, that extract of Opium, combined with camphor, and purified nitrate of potash, and dissolved in a small quantity of emulsion, and given in small doses, acts most favourably - 2nd That Amputation performed at a proper

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time is the most certain means of arresting tetanus when it proceeds from a wound on the extremities. Much time might be taken up in mentioning the plans pursued by different practitioners who are loud in praise of them, but I shall pass them by and mention only that followed by our highly distinguished professor Doctor Physick. His practice is to administer Opium by the rectum largely and at short intervals and rub quantities of mercurial ointment over the body to induce salivation when this is effected the patient is considered in a favourable way. I would here suggest the propriety of making use of fumigations to assist in effecting the salivation Opium and Mercury may, since supported by such experience, be considered as remedies on which much reliance may be placed in Tetanus. The caustic potash should also stand among the foremost of our remedies

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